



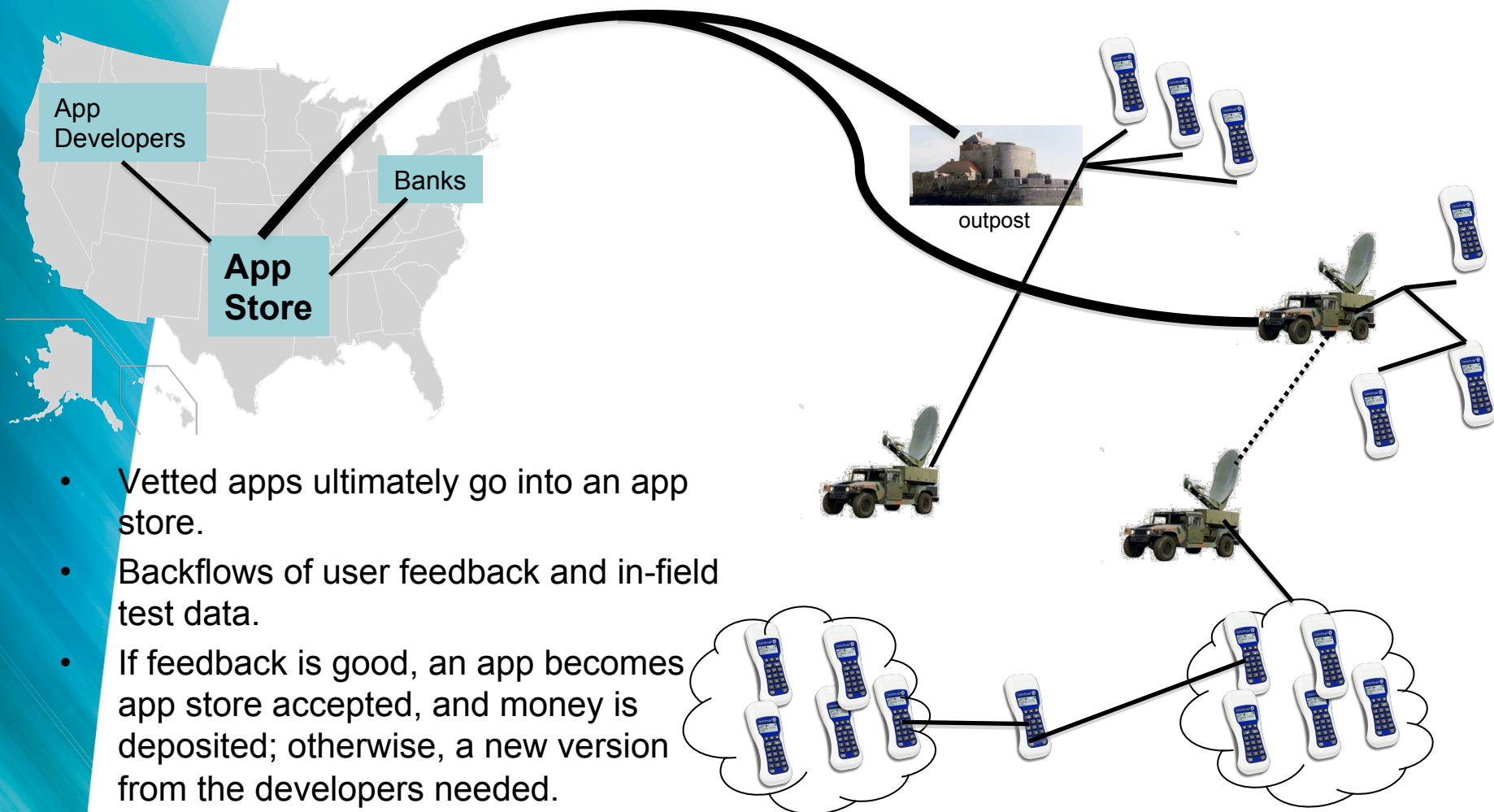
# Vetting Applications

Jeff Voas & Angelos Stavrou

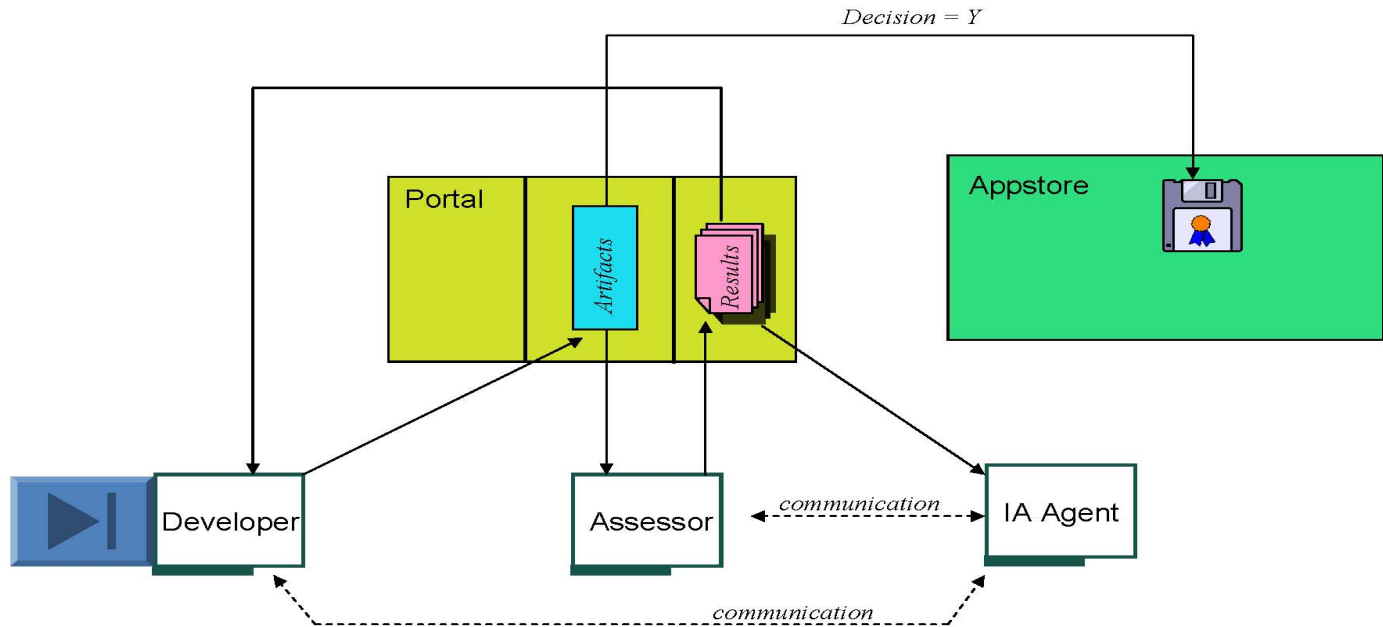
NIST

George Mason University

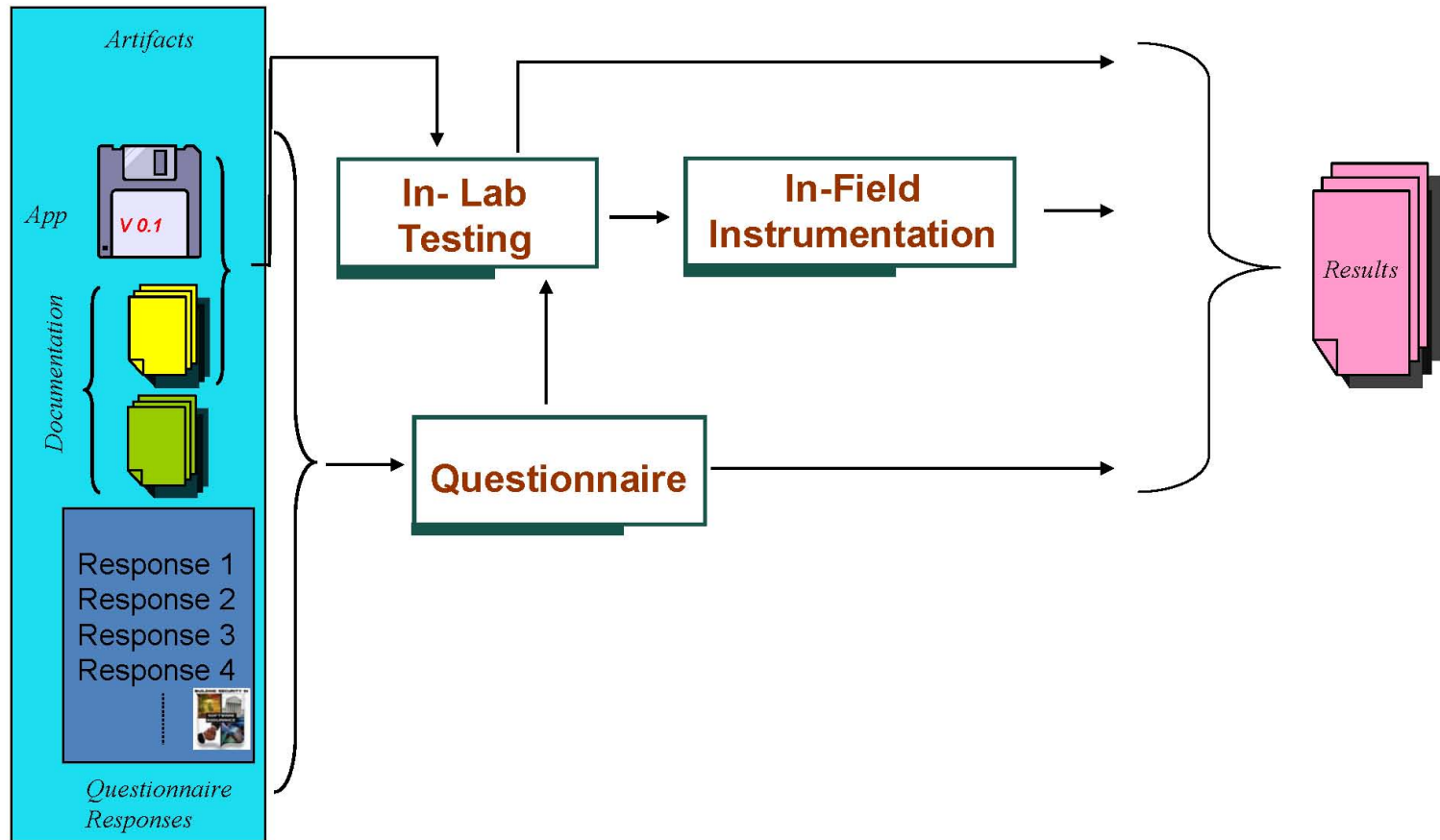
# High-Level Project Overview



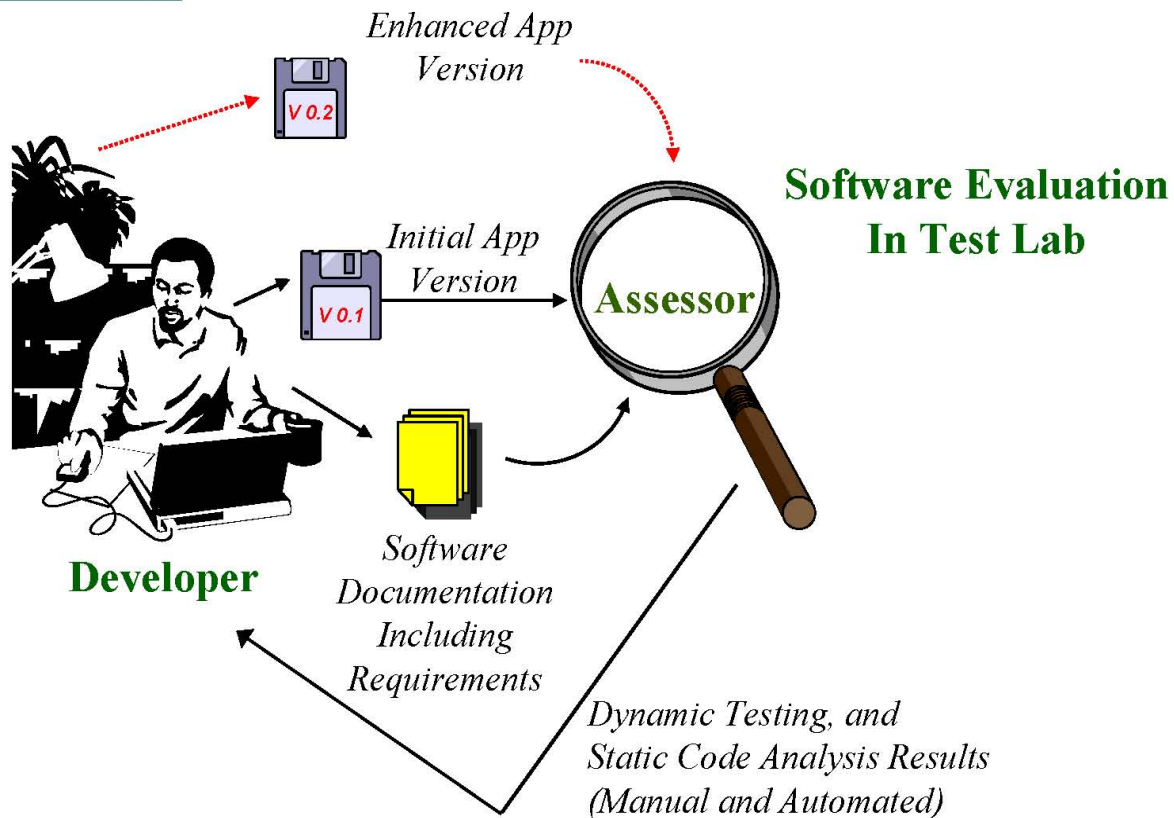
# Application Vetting: Big Picture



# Progression of Testing



## In-Lab Testing Process



# What about existing Analysis Tools?

- Commercial application testing tools cover regular, non-Android specific Bugs:
  - No Security Analysis of the Code Functionality
  - No Power Analysis of the Application components and code
  - No Profiling of the resource consumption of individual applications
  - Cannot Regulate/Deny the access and use of phone subsystems (Camera, Microphone, GPS..)
- Existing tools **do not cover Program Functionality**
  - We reveal the application capabilities and access





# Application Testing Framework

Application Static Analysis does not cover  
**Program Functionality**

Fortify, Coverity, and other application testing tools cover regular, non-Android **specific Bugs**:

- No Security Analysis of the Code Functionality
- No Power Analysis of the Application components and code
- No **Profiling** of the resource consumption of individual applications
- **Cannot Regulate/Deny** the access and use of phone subsystems (Camera, Microphone, GPS..)

# App Vetting & Control

- App Signing – Prevent unauthorized App Execution
  - Approved Apps are signed by the program designated approval authority
  - Only program signed Apps can be installed on the device
    - Customizations made to Android package framework
- App Analysis & Testing
  - All Apps are analyzed for malware and potential vulnerabilities
    - AV Scans
    - Vulnerability Scans (Fortify)
  - Expose hidden & unwanted functionality
    - Hidden in Native Libraries
    - Dynamic or obfuscated code
  - Permissions manifest reconciliation against code



# Android Application Control

- Application Signing – Prevent unauthorized App Execution
  - Approved Apps are signed by the program designated approval authority
  - Only program signed Apps can be installed on the device
    - Customizations made to Android package framework
- Application Stress Testing
  - Measure Power Consumption
  - Identify Input Errors / Find UI bugs

# Application Analysis Framework

- Android Specific Analysis includes analysis of the Application Security Manifest
  - Tailored to the Android Permission Model
- Verify if the requested permissions are warranted by the submitted code
  - Remove excessive permissions & enforce a tighter security model
- Regulate access to critical/restricted resources
  - Modifications on the Android Engine to enable dynamic policies
  - Control the underlying Dalvik engine to report absence/depletion of resources instead of lack of permissions



# Application Policy Enforcement

## Solution: Per Application Policy Enforcement

Provide Dalvik mechanisms to

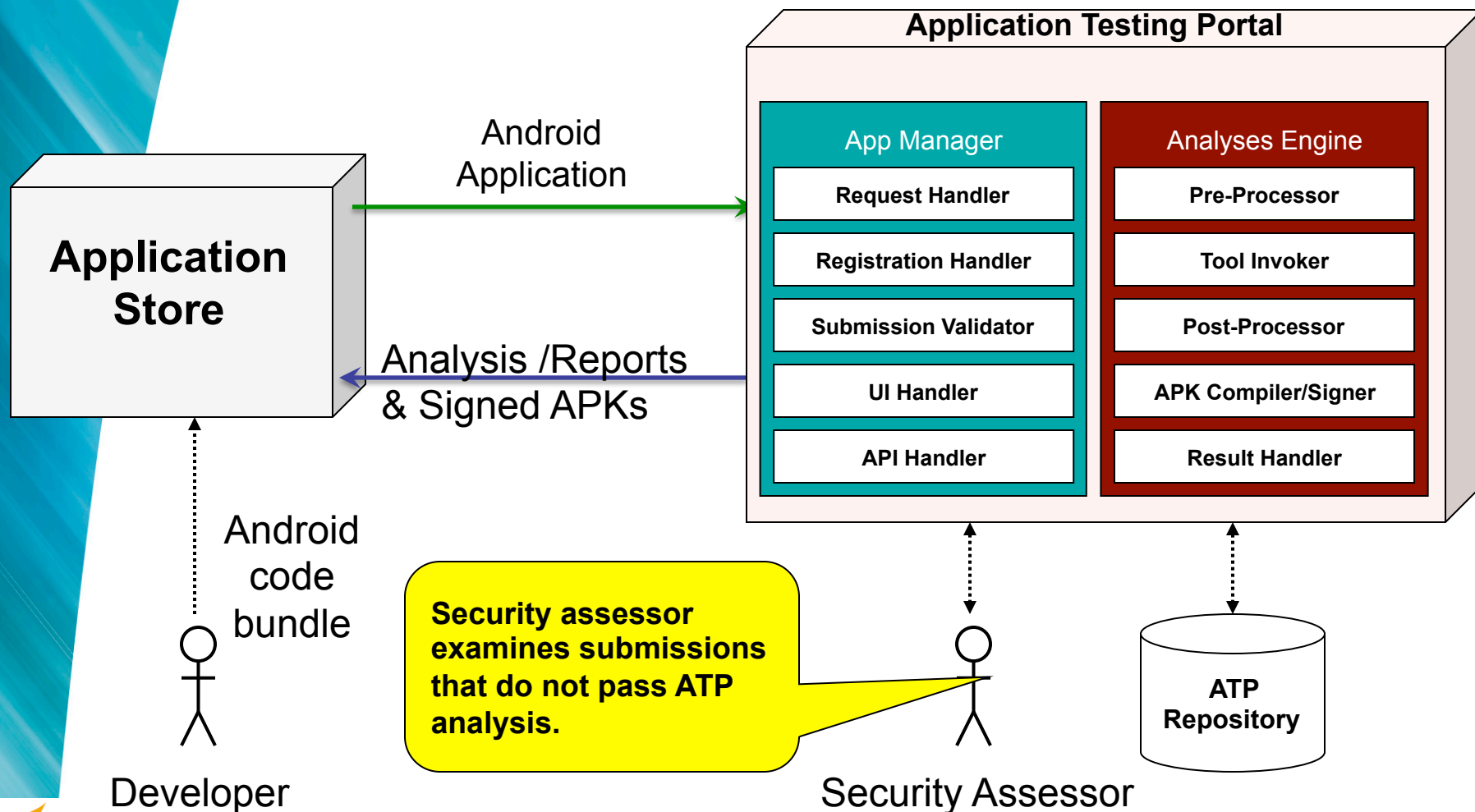
- Enforce application Access & Capabilities
  - Tailored to specific Location or Time
  - Tailored to specific Mission
- Application can still be installed but deprived access to resources and data selectively

Policy Enforcement paired with Device Security can significantly reduce the risk of **Data Exfiltration**

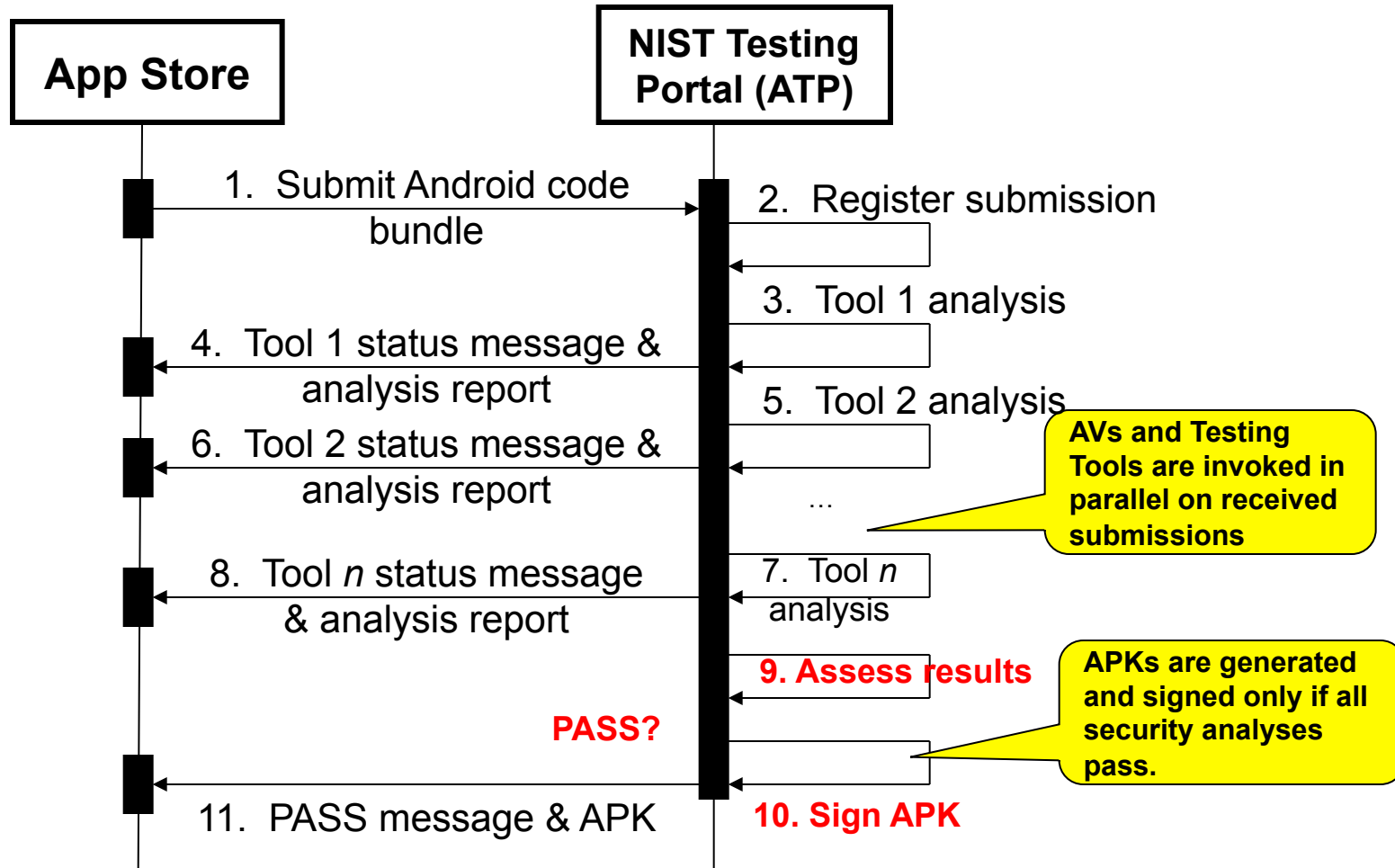
# Power Metering Framework

- Design & Implement an accurate model for **accounting and policing** energy consumption
- Two-pronged approach
  - Meter the **per-process** CPU & Device utilization over time
  - Identify the **relative impact of each device** component on energy consumption
- Design an **Android kernel subsystem** to estimate energy
  - Meter energy consumption for each App/process
  - Use for characterizing application behavior
  - This behavior is **Application dependent**
  - Sometimes the behavior is also **User dependent**

*ATP analyzes Android code bundles and returns messages, analysis reports, and signed APKs*



*ATP applies Testing to Analyze Android code bundles*





# ATP Monitor

App Testing Portal - Windows Internet Explorer

https://appsec.nis... App Testing Portal

## NIST App Testing Portal

steveq logged in

**Contents**  
  
[ViewApps](#)  
[SubmitApp](#)  
[Account](#)  
[Documents](#)  
[Log out](#)

**Registered Apps**

App ID	Name	Submitted	Status	Submitter	Approved
3665043	Illumination-test	2011-11-16 14:44:26.0	ANDROID COMPILE ERROR	cnri	REJECTED
7238834	Illumination-test	2011-11-16 14:54:47.0	ANDROID COMPILE ERROR	cnri	REJECTED
1423329	Illumination-test	2011-11-16 14:56:26.0	ANDROID UPDATE OK	cnri	TBD
5766277	Illumination-test	2011-11-16 15:09:31.0	ANDROID COMPILE ERROR	cnri	REJECTED
130670	DariToEnglish2.3	2011-11-16 15:10:53.0	ANALYSIS COMPLETE	cnri	APPROVED
426641	Illumination-test	2011-11-16 15:33:06.0	ANDROID COMPILE ERROR	cnri	REJECTED
8276571	DariToEnglish2.3	2011-11-16 15:34:34.0	ANALYSIS COMPLETE	cnri	APPROVED
6052763	Illumination-test	2011-11-16 16:17:04.0	ANDROID COMPILE ERROR	cnri	REJECTED
6489049	Illumination-test	2011-11-16 16:20:23.0	ANDROID COMPILE ERROR	cnri	REJECTED
8460629	DariToEnglish2.3	2011-11-16 16:58:59.0	ANALYSIS COMPLETE	steveq	APPROVED
5809194	Illumination-test	2011-11-17 09:59:41.0	ANALYSIS COMPLETE	cnri	APPROVED
5560815	DariToEnglish2.3	2011-11-17 10:34:36.0	ANALYSIS COMPLETE	cnri	APPROVED
6130090	Illumination-test	2011-11-17 10:46:40.0	ANALYSIS COMPLETE	cnri	APPROVED
9740421	Illumination-test	2011-11-17 11:45:20.0	ANDROID COMPILE ERROR	cnri	REJECTED
982873	DariToEnglish2.3	2011-11-17 11:47:03.0	ANALYSIS COMPLETE	cnri	APPROVED
101711	Illumination-test	2011-11-17 12:50:58.0	ANDROID COMPILE ERROR	cnri	REJECTED

# Defense in-Depth: Multiple Levels of Security

- ❖ Application Vetting & Testing
- ❖ Device Lock-down and Encryption of ALL Data and Communications
- ❖ Enforcement of Security Policies in the Android Framework
- ❖ Second-level Defenses placed in the Android Linux Kernel
  - ❖ Prevent Attacks that bypass Android Security Framework
  - ❖ Android has Inherited some (if not all) of the Linux Vulnerabilities
  - ❖ **Java Native Interface to Linux Libraries a potential Avenue for Exploitation**

# Conclusions

Assuring the Secure Operation of Smart Devices has a wide-range of requirements

- ❖ Application Testing
  - ❖ Static & Dynamic
  - ❖ In-Field Instrumentation
  - ❖ Power Behavior Metering & Policing
- ❖ Physical Device Security
  - ❖ Lock-Down of the Device I/O (USB, WiFi, etc.)
  - ❖ Encryption of Data both on the Phone & Network
  - ❖ Securing Provisioning Process